

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

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(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 9363SG7/JFC	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. <b>PCT/SG2002/000287</b>	International Filing Date (day/month/year) <b>9 December 2002</b>	Priority Date (day/month/year) <b>9 December 2002</b>
International Patent Classification (IPC) or national classification and IPC <b>Int. Cl. 7 G03F 1/00, 1/16, 7/00, 7/20, H01L 21/027</b>		
Applicant <b>SYSTEMS ON SILICON MANUFACTURING CO. PTE. LTD. et al</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheet(s).

3. This report contains indications relating to the following items:

- I  Basis of the report
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand <b>15 June 2004</b>	Date of completion of the report <b>7 October 2004</b>
Name and mailing address of the IPEA/AU <b>AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929</b>	Authorized Officer  <b>RAJEEV DESHMUKH</b> Telephone No. (02) 6283 2145

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/SG2002/000287

**I. Basis of the report****1. With regard to the elements of the international application:\***

the international application as originally filed.

the description, pages 1-19, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of

the claims, pages , as originally filed,  
pages , as amended (together with any statement) under Article 19,  
pages , filed with the demand,  
pages 21-24, received on 1 October 2004 with the letter of 1 October 2004

the drawings, pages 1/13-13/13, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of

the sequence listing part of the description:  
pages , as originally filed  
pages , filed with the demand  
pages , received on with the letter of

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language which is:

the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

the language of publication of the international application (under Rule 48.3(b)).

the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:**

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

**4.  The amendments have resulted in the cancellation of:**

the description, pages

the claims, Nos.

the drawings, sheets/fig.

**5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/SG2002/000287

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims 1–30	YES
	Claims	NO
Inventive step (IS)	Claims 1–30	YES
	Claims	NO
Industrial applicability (IA)	Claims 1–30	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

US 2001/0024758 A1 discloses sizing the patterns depending on the space between these patterns but only one sizing rule is applied to the whole reticle. It does not disclose or suggest sizing of the apertures depending on dimensions of the corresponding features.

In US 5208124 A, the reticle patterns are sized based on proximity of reticle patterns and different sizing rules are applied to a single reticle. There is no disclosure or suggestion of sizing rules for the apertures based on the dimensions of corresponding features.

US 4895780 A discloses solving the problem of proximity effects using adjustable windage method. It does not disclose or suggest the sizing of apertures depending on relative isolation or dimensions of corresponding features.

WO 2002/073312 A1 discloses different features with different dimensions but it uses phase shift mask technique in addition to conventional binary masks for producing integrated circuits. It does not disclose or suggest the sizing of apertures depending on relative isolation or dimensions of corresponding features.

US 5686208 A uses a more complicated method to fabricate an alternating aperture phase shifting mask. It does not disclose or suggest the sizing of apertures depending on relative isolation or dimensions of corresponding features.

None of the cited documents discloses or (individually or in an obvious combination) suggests the invention as claimed in claims 1– 30 wherein different sizing rules depend respectively on the relative isolation of first type features and the dimensions of second type features. Therefore the claimed invention is novel, involves an inventive step, and is industrially applicable.

CLAIMS

1. A method for use in designing a reticle for exposing a substrate during production of a circuit, comprising:
  - 5 determining the relative isolation of at least some of the features to be produced using said reticle; andsizing the corresponding apertures in said reticle according to the determined relative isolation.
- 10 2. A method for use in designing a reticle for exposing a substrate during production of a circuit, comprising:
  - determining a first dimension of at least some of the features to be produced using said reticle; andsizing the corresponding apertures in said reticle by different amounts and proportions according to the determined first dimension.
- 15 3. A method for use in designing a reticle for exposing a substrate during production of a circuit, comprising:
  - determining the relative isolation of at least some of the features to be produced using said reticle and sizing the corresponding apertures in said reticle according to the determined relative isolation; anddetermining a first dimension of at least some of the features to be produced using said reticle and sizing the corresponding apertures in said reticle by different amounts and proportions according to the determined first dimension.
- 20 4. A method according to claim 1 or 3, wherein the results of the relative isolation determining step cause the more isolated apertures to be made larger.
5. A method according to claim 1, 3 or 4, wherein the relative isolation is determined against a first threshold, with the more isolated apertures being sized a first way and the less isolated sized a second way.
- 30 6. A method according to claim 1, 3, 4 or 5, wherein there are at least two classes of features and the relative isolation determining step is performed on apertures corresponding to a first class of features.

7. A method according to claim 2 or 3, or according to any one of claims 4 to 6 when dependent on at least claim 3, wherein there are at least two classes of features and the first dimension determining step is performed on apertures corresponding to a second class of features.  
5
8. A method according to claim 7, further comprising the step of extending the size of at least some of said second class of apertures in a second dimension orthogonal to the first dimension.  
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9. A method according to claim 2 or 3, or according to any one of claims 4 to 8 when dependent on at least claim 2 or 3, wherein the results of the first dimension determining step cause the smaller apertures to be made larger.  
15
10. A method according to any one of the preceding claims, wherein the features comprise holes and slits.  
11. A method according to claim 10, when dependent on at least claim 7, wherein the holes belong to said first class.  
20
12. A method according to claim 10 or 11, when dependent on at least claim 8, wherein the slits belong to said second class.  
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13. A method according to claim 2 or 3, or according to any one of claims 4 to 12 when dependent on at least claim 2 or 3, wherein the results of the first dimension determining step cause apertures to be sized in a second dimension, orthogonal to the first dimension.  
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14. A method according to claim 2 or 3, or according to any one of claims 4 to 12 when dependent on at least claim 2 or 3, wherein the apertures corresponding to features with the smaller first dimension are increased in the second dimension more than those with the larger first dimension  
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15. A method according to claim 2 or 3, or according to any one of claims 4 to 14 when dependent on at least claim 2 or 3, wherein the first dimension is compared

with a second threshold, with the larger apertures being sized a third way and the smaller sized a fourth way.

16. A method according to claim 2 or 3, or according to any one of claims 4 to 13  
5 when dependent on at least claim 2 or 3, wherein the first dimension of a feature is the length of said feature.
- 10 17. A method according to any one of the preceding claims, wherein the features are features of memory cells.
18. A method according to any one of the preceding claims, wherein the reticle is a Half-Tone Phase Shift Mask.
- 15 19. A method according to any one of the preceding claims for producing features for a local interconnect layer.
- 20 20. A reticle for exposing a substrate during production of a circuit, comprising:  
a first class of apertures, whose sizes are dependent on the relative isolation of the features to be produced thereby.
21. A reticle for exposing a substrate during production of a circuit, comprising:  
a second class of apertures, whose sizes are dependent on a first dimension of the features to be produced thereby, with said second class of apertures being sized with different relative and absolute amounts, relative to the sizes of the features to be produced, according to the size in a first dimension of the features to be produced.  
25
22. A reticle for exposing a substrate during production of a circuit, comprising:  
a first class of apertures, whose sizes are dependent on the relative isolation of the features to be produced thereby; and  
a second class of apertures, whose sizes are dependent on a first dimension of the features to be produced thereby, with said second class of apertures being sized with different relative and absolute amounts, relative to the sizes of the features to be produced, according to the size in a first dimension of the features to be produced.  
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## ART 34 AMDT

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23. A reticle according to claim 20 or 22, wherein the more isolated apertures are relatively larger than the less isolated apertures for the size of features to be produced.
- 5 24. A reticle according to claim 20, 22 or 23, wherein there are at least two classes of features and the relative isolation affects only apertures corresponding to a first class of apertures.
- 10 25. A reticle according to claim 21 or 22, or according to any one of claims 23 and 24 when dependent on at least claim 22, wherein there are at least two classes of features and the first dimension affects only apertures corresponding to a second class of apertures.
- 15 26. A reticle according to any one of claims 20 to 25, wherein the features comprise holes and slits.
- 20 27. A reticle according to claim 26, when dependent on at least claim 24, wherein the holes belong to said first class.
28. A reticle according to claim 26 or 27, when dependent on at least claim 25, wherein the slits belong to said second class.
- 25 29. A reticle according to claim 21 or 22, or according to any one of claims 23 to 28 when dependent on at least claim 21 or 22, wherein the size in the first dimension determines size in a second dimension, orthogonal to the first dimension.
- 30 30. A reticle according to claim 21 or 22, or according to any one of claims 23 to 29 when dependent on at least claim 21 or 22, wherein the features determined to be small in the first dimension are larger in the second dimension than those determined to be the larger in first dimension.
31. A reticle according to claim 21 or 22, or according to any one of claims 23 to 30 when dependent on at least claim 21 or 22, wherein larger and smaller in the first dimension is determined by comparison with a threshold.

32. A reticle according to claim 21 or 22, or according to any one of claims 23 to 31 when dependent on at least claim 21 or 22, wherein the first dimension of a feature is the length of said feature.

5 33. A reticle according to any one of claims 20 to 32, wherein the features are features of memory cells.

34. A reticle according to any one of claims 20 to 33, wherein the reticle is a Half-Tone Phase Shift Mask.

10 35. A reticle according to any one of claims 20 to 34, being a reticle for a local interconnect layer reticle.

15 36. A method of producing an integrated circuit comprising the steps of:  
designing a reticle in accordance with the method of any one of claims 1 to 19;  
and  
using said reticle to expose at least one layer of at least a portion of the integrated circuit.

20 37. A method of producing an integrated circuit comprising using a reticle as defined in any one of claims 20 to 35 to print at least a portion of said integrated circuit.

38. An integrated circuit, at least a portion of which is produced using a reticle as defined in any one of claims 20 to 35.

**AMENDED CLAIMS**

[Received by the International Bureau on 29 January 2004 (29.01.04):  
original claims 1-38 replaced by amended claims 1-30 (4 pages)]

**CLAIMS**

1. A method for use in designing a reticle for exposing a substrate during production of a circuit, comprising:
  - 5 determining the relative isolation of features of a first class to be produced using said reticle and sizing first class feature apertures in said reticle, which first class feature apertures correspond to the first class features, according to the determined relative isolation; and
    - 10 determining a first dimension of features of a second class to be produced using the same reticle and sizing second class feature apertures in said same reticle, which second class feature apertures correspond to the second class features, by different amounts and proportions according to the determined first dimension.
2. A method according to claim 1, wherein the results of the relative isolation determining step cause the more isolated apertures to be made larger.
  - 15
3. A method according to claim 1 or 2, wherein the relative isolation is determined against a first threshold, with the more isolated apertures being sized a first way and the less isolated sized a second way.
  - 20
4. A method according to any one of the preceding claims, further comprising the step of extending the size of at least some of said second class feature apertures in a second dimension orthogonal to the first dimension.
- 25 5. A method according to any one of the preceding claims, wherein the results of the first dimension determining step cause smaller apertures to be made larger.
6. A method according to any one of the preceding claims, wherein the first class of features comprises a plurality of holes.
  - 30
7. A method according to any one of the preceding claims, wherein the second class of features comprises a plurality of slits.

8. A method according to any one of the preceding claims , wherein the results of the first dimension determining step cause apertures to be sized in a second dimension, orthogonal to the first dimension.
- 5 9. A method according to any one of the preceding claims, wherein the apertures corresponding to features with the smaller first dimension are increased in the second dimension more than those with the larger first dimension
- 10 10. A method according to any one of the preceding claims, wherein the first dimension is compared with a second threshold, with the larger apertures being sized a third way and the smaller sized a fourth way.
11. A method according to any one of the preceding claims, wherein the first dimension of a feature is the length of said feature.
- 15 12. A method according to any one of the preceding claims, wherein the features are features of memory cells.
- 20 13. A method according to any one of the preceding claims, wherein the reticle is a Half-Tone Phase Shift Mask.
14. A method according to any one of the preceding claims for producing features for a local interconnect layer.
- 25 15. A reticle for exposing a substrate during production of a circuit, comprising:  
a plurality of first class feature apertures, whose sizes are dependent on the relative isolation of features of a first class to be produced thereby; and  
a plurality of second class feature apertures, whose sizes are dependent on a first dimension of features of a second class to be produced thereby, with said second class of apertures being sized with different relative and absolute amounts, relative to the sizes of the features to be produced, according to the size in a first dimension of the features to be produced.
- 30 35 16. A reticle according to claim 15, wherein the more isolated apertures are relatively larger than the less isolated apertures for the size of features to be produced.

17. A reticle according to claim 15 or 16, wherein the first class feature apertures are apertures for producing holes.

5 18. A reticle according to any one of claims 15 to 17, wherein the second class feature apertures are apertures for producing slits.

19. A reticle according to any one of claims 15 to 18, wherein the size in the first dimension determines size in a second dimension, orthogonal to the first dimension.

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20. A reticle according to any one of claims 15 to 19, wherein the features determined to be small in the first dimension are larger in the second dimension than those determined to be the larger in first dimension.

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21. A reticle according to any one of claims 15 to 20, wherein larger and smaller in the first dimension is determined by comparison with a threshold.

22. A reticle according to any one of claims 15 to 21, wherein the first dimension of a feature is the length of said feature.

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23. A reticle according to any one of claims 15 to 22, wherein the features are features of memory cells.

24. A reticle according to any one of claims 15 to 23, wherein the reticle is a Half-Tone Phase Shift Mask.

25. A reticle according to any one of claims 15 to 24, being a local interconnect layer reticle.

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26. A reticle designed according to the method of any one of claims 1 to 14.

27. A reticle according to any one of claims 15 to 25, designed according to the method of any one of claims 1 to 14.

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28. A method of producing an integrated circuit comprising the steps of:

designing a reticle in accordance with the method of any one of claims 1 to 14;  
producing the so designed reticle; and  
using said reticle to expose features of both the first and second classes in a  
single step in at least one layer of at least a portion of the integrated circuit.

5

29. A method of producing an integrated circuit comprising using a reticle as defined in any one of claims 15 to 27 to print features of both the first and second classes in a single step in at least a portion of said integrated circuit.

10 30. An integrated circuit, at least a portion of which is produced using a reticle as defined in any one of claims 15 to 27.